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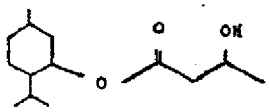
(54) 3-hydroxybutyrate de L-menthyle, procédé pour sa préparation et agent de refroidissement le contenant.

(57) Selon l'invention, on fournit le 3-hydroxybutyrate de L-menthyle de formule (I)



et un procédé pour sa préparation.

Ce composé est utilisable comme agent de refroidissement pour divers produits tels que des produits alimentaires, des boissons, des cosmétiques, des produits médicinaux, etc. L'addition de ce composé confère un effet de refroidissement aux substances ainsi traitées.

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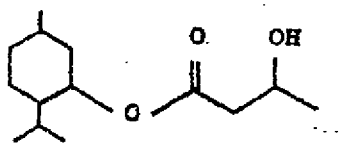
The invention relates to L-menthyl 3-hydroxybutyrate corresponding to formula (I)



(I)

to its production and to a cooling agent containing compound (I) as an active ingredient. This cooling agent has a cooling activity, and when used as an additive in various products such as food substances, beverages, cosmetics and medicinal drugs, it imparts a cooling effect (refreshing sensation). Consequently, this cooling agent enhances the value of various products.

Various compounds are known which impart a cooling effect when applied to or in contact with the skin or mucous membrane, particularly that of the mouth, nose and throat of the human body. A typical example of such a compound is menthol, a major component of peppermint essence. The cooling activity of menthol is believed to be due not to the latent heat of evaporation of menthol itself but to a direct irritating action on a heat-sensitive receptor at the nerve endings in the human body; this irritating action in turn acts on the central nervous system, then producing a cooling effect.

In the field, menthol has been quite widely used in food products, beverages, cosmetics, medicinal drugs, dentifrices and for treating tobacco and the like. However, menthol has a strong peppermint odor and dissipates rapidly in air because of its high volatility.

The cooling effect due to menthol thus does not persist for very long, so

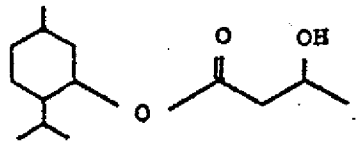
the uses of menthol have been very limited.

Besides menthol, various compounds are known to possess a cooling activity. These compounds are described in the following patents and patent applications: *p*-menthane substituted in position 3 (published Japanese patent applications Nos. 16647/1972 and 16649/1972; *N*-substituted *p*-menthane-3-carboxyamides (published Japanese patent application No. 16648/1972); *p*-menthanediols (published Japanese patent application No. 16650/1972); *N*-substituted ureas (published Japanese patent application No. 142737/1975); 3-menthoxypropane-1,2-diols (published Japanese patent application No. 88334/1983); tricyclic alcohols (published Japanese patent applications Nos. 219208/1984 and 219243/1984).

The menthol and other compounds mentioned above have the following drawbacks: (1) low cooling activity, (2) short duration of their cooling effect, (3) strong odor, (4) unpleasant bitter taste, (5) low safety, (6) inferiority in terms of certain chemical properties such as stability and solubility, (7) high production cost.

It was therefore attempted to devise a new compound having a cooling activity not associated with the disadvantages listed above.

To remedy the drawbacks observed in the known compounds listed above, the applicant conducted research aimed at synthesizing various L-menthol derivatives and examined the properties of these derivatives. This research led to the discovery that a new compound, L-menthyl 3-hydroxybutyrate, of the formula

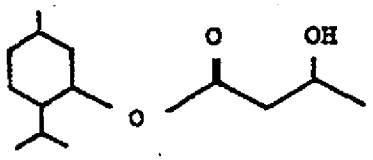


exhibits excellent cooling activity and imparts a cooling effect when used in food products, beverages, medicinal drugs, dentifrices, tobacco and others.

In the attached drawings:

Figures 1, 2 and 3 represent the IR spectrum, MS spectrum and NMR spectrum of L-menthyl 3-hydroxybutyrate.

The first object of the invention is L-menthyl 3-hydroxybutyrate of formula (I)

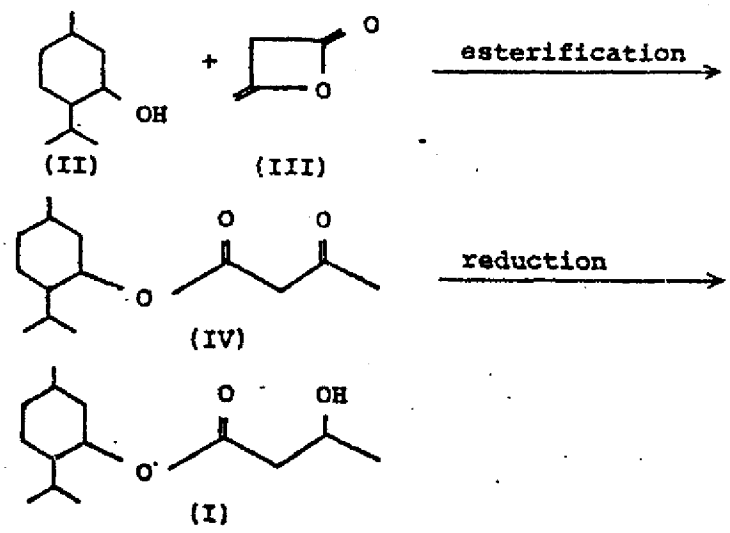


(I)

The second object of the invention is a process for preparing a new compound, L-menthyl 3-hydroxybutyrate, of formula (I) above, consisting of reacting L-menthol with diketene in the presence of an alkaline catalyst to obtain L-menthyl acetoacetate, then reducing the L-menthyl acetoacetate.

Furthermore, the third object is a cooling agent containing the L-menthyl 3-hydroxybutyrate as an active ingredient. This cooling agent produces a cooling effect when used as an additive in various products such as food products and beverages.

The L-menthyl 3-hydroxybutyrate of the invention may be prepared by the following reaction using L-menthol (II) and diketene (III) as starting materials.



In the first stage of this reaction process, L-menthyl acetoacetate (IV) is obtained from L-menthol (II) and diketene (III) by the esterification reaction. This first stage reaction is conducted in the presence of an alkaline catalyst at a temperature ranging from 50 to 130°C, preferably from 90 to 110°C. Examples of such an alkaline catalyst used for the first stage reaction are sodium carbonate, potassium carbonate, sodium acetate, sodium hydroxide and others, and the preferred catalyst is potassium carbonate or sodium acetate.

By way of example, this first stage reaction can be conducted as follows: 0.05-0.1 g of an alkaline catalyst such as potassium carbonate or sodium acetate is added to 1 mole (156 g) of L-menthol, and the resulting mixture is stirred for some time. 1.05-1.10 mole of diketene is added dropwise to the mixture while maintaining the temperature of the mixture between 90 and 110°C so that the L-menthyl acetoacetate (IV) is obtained in the absence of any solvent at a high yield (95% or more).

The L-menthyl acetoacetate can also be prepared in a conventional manner such as an ester exchange reaction (interesterification) between L-menthol and ethyl acetoacetate. However, when diketene is used in the first stage as in the invention, the L-menthyl acetoacetate can be obtained at a higher yield, and this L-menthyl acetoacetate can advantageously be used in the next stage of the reaction (reduction) without using a separation operation for the reaction mixture.

In the second stage of the reaction process, the L-menthyl acetoacetate is reduced by chemical reduction or catalytic hydrogenation to obtain L-menthyl 3-hydroxybutyrate.

A suitable example of a reduction agent for this chemical reduction is a reduction agent of a moderate type that does not exert any effect on the ester group and selectively reduces the carbonyl group. In the field, examples of such reducing agents include sodium borohydride, lithium borohydride, *t*-butoxyaluminum hydride and lithium hydride. The preferred reducer is sodium borohydride. In this chemical reduction the L-menthyl acetoacetate is reduced to a temperature ranging from -20 to 20°C, preferably from -5 to 5°C. When the reaction is conducted at a temperature in excess of 20°C, there is a risk of undesirable cleavage of the ester bond.

This chemical reduction can be conducted, for example, as follows: 1 liter of isopropyl alcohol is mixed with 10-13 g of sodium borohydride, and the resulting mixture is stirred to obtain a homogeneous product. To the mixture is added dropwise a solution of 1 mole (240 g) of L-menthyl acetoacetate in 100 mL of isopropyl alcohol, maintaining the temperature of the mixture between -5 and 5°C to obtain the desired product, L-menthyl

3-hydroxybutyrate, at a yield as high as 95% or higher.

When this second stage of the reaction process is conducted by catalytic hydrogenation, the L-menthyl acetoacetate is placed in a reactor with a reducing catalyst such as Raney nickel, a copper-chromite catalyst, etc, and the L-menthyl acetoacetate is hydrogenated by introducing a hydrogen stream at a pressure of 980-9800 kPa (10-100 kg/cm^2), preferably 5880-7840 kPa, at a temperature of 60-120°C, preferably 90-100°C. When the reaction is conducted at a temperature in excess of 120°C, there is a risk of undesirable cleavage of the ester bond.

The catalytic hydrogenation can be conducted, for example, as follows: 1 mole (240 g) of L-menthyl acetoacetate is introduced with 2-3 g of Raney nickel into an autoclave, and the L-menthyl acetoacetate is hydrogenated under a pressure of 6860 kPa of hydrogen at a temperature of 95-100°C so that the L-menthyl acetoacetate absorbs the theoretical quantity of hydrogen. Thus the L-menthyl 3-hydroxybutyrate is obtained at a high yield (90%).

L-Menthyl 3-hydroxybutyrate is a colorless, odorless liquid that is readily soluble in the solvents that may normally be used for food products, beverages and cosmetics, such as ethyl alcohol, propylene glycol, triethyl citrate, benzyl benzoate and dioctyl phthalate. This compound is also soluble in 50% aqueous ethyl alcohol up to a concentration of about 23%. Consequently, L-menthyl 3-hydroxybutyrate is quite satisfactory for practical applications.

The stability of this compound in a 2% solution in ethanol-water (1:1, vol/vol) was verified by monitoring the degradation over time at different pH's at 43°C. In this test we observed that L-menthyl- 3-hydroxybutyrate

hydrolyzes slowly under alkaline conditions, at pH 11.0, to form menthol, but under neutral to acid conditions, such as pH 6.7 and 4.2, its hydrolysis is so slight that the decomposition rate of the L-menthyl 3-hydroxybutyrate is only about 1% even after six months of storage. This confirms the satisfactory stability of L-menthyl 3-hydroxybutyrate for practical applications.

L-Menthyl 3-hydroxybutyrate is also found to be a useful, hazardless, safe compound for humans, since it exhibits negative reactions in all the tests such as a primary stimulation test, a phototoxicity test and a sensitization test in guinea pigs (shaved skin); it is decomposed by microorganisms in a biodegradation test with microorganisms; it exhibits a negative reaction in the mutagenicity test on certain microorganisms such as *Salmonella typhimurium* (TA100, TA98 and TA1538) and *Escherichia coli* (WP-2), and its DL_{50} in male rats, given L-menthyl 3-hydroxybutyrate orally, is 10,300 mg/kg.

The L-menthyl 3-hydroxybutyrate of the invention can be used as a cooling agent without any carrier compound but may also be used in a composition in different forms, for example, in the form of a solution such as a solution in alcohol, propylene glycol and benzyl benzoate; in the form of an emulsion in a mixture with an appropriate emulsifier; in the form of a powder prepared by absorption of L-menthyl 3-hydroxybutyrate on starch or talc; in the form of a liquid for aerosol atomization with low boiling point hydrocarbons or with low boiling point halogenated hydrocarbons. The L-menthyl 3-hydroxybutyrate formulated in the different forms listed above is used as an additive for different types of products, for example, for food products and beverages such as chewing gum, candy, cold confections (ice creams, etc) and soft drinks; for

cosmetics such as creams, lotions, powder, hair tonics, shampoos and lipsticks; for medicinal products such as ointments, bandages, internal medicines and cough drops; dentifrices, mouthwashes; tobacco; tobacco filters, etc. The cooling agent of the invention may also be formulated for different practical applications with one or more acceptable or edible pharmaceutical additives, for example, in combination with preservatives, antioxidants, perfumes, coloring agents, surface active agents, etc. The cooling agent of the invention may be used in a wide range of concentrations, but preferably at a concentration of 0.001-10% by weight, calculated as L-menthyl 3-hydroxybutyrate.

The following nonlimiting examples are given to illustrate the invention.

Reference Example

Preparation of L-Menthyl Acetoacetate

A 2 liter flask equipped with a stirrer and a reflux coolant is first scavenged with gaseous nitrogen; then 1 kg (6.41 moles) of L-menthol and 0.5 g of sodium acetate are introduced. The mixture of L-menthol and sodium acetate is heated in a nitrogen current while stirring. When the temperature of the mixture reaches 90°C, 6.94 moles (582 g) of diketene is added dropwise over 2 hours to produce the esterification reaction. This reaction is exothermic, and the reaction mixture must possibly be cooled to a reaction temperature of 90-110°C. When the addition of ketene is completed, the reaction mixture is again stirred for 2 hours to continue the reaction, with the same temperature maintained until the reaction is completed. Thus, a raw L-menthyl acetoacetate (about 95% pure) is obtained at a yield of 1582 g. The raw L-menthyl acetoacetate is used without further purification as a starting material (reduction) for the reaction process.

Example 1

Preparation of L-Menthyl 3-Hydroxybutyrate by Chemical Reduction

A 3 liter flask equipped with a stirrer is first scavenged with gaseous nitrogen; 2 liters of isopropyl alcohol and 25.2 g (0.667 mole) of sodium borohydride are then introduced. The mixture is cooled to -5°C by immersing the flask in a dry ice-acetone bath. A solution of raw L-menthyl acetoacetate (about 95% pure) (505 g, 2 moles) obtained in the reference example, in 200 mL of isopropyl alcohol, is added dropwise over 3 hours, with stirring in a gaseous nitrogen current to produce the reducing reaction. The reaction is continued while maintaining the temperature of the reaction mixture between -5 and 0°C. After the solution of raw L-menthyl acetoacetate in isopropyl alcohol is added, the reaction mixture is stirred for another hour, with the same temperature maintained so that the reaction is complete. 237 g of 10% aqueous hydrochloric acid is added dropwise to the resulting reaction mixture over about 1 hour with stirring and with the temperature of the reaction mixture maintained between 0 and 5°C in order to decompose the excess sodium borohydride. The reaction mixture is then neutralized with 10% sodium bicarbonate and distilled under vacuum (at a temperature of less than 40°C) to evaporate the isopropyl alcohol. After the isopropyl alcohol is eliminated from the mixture, the latter is concentrated. The resulting concentrated product is mixed with 1 liter of toluene and transferred to a separatory funnel. The mixture is washed in the separatory funnel with 1 liter of a saturated aqueous solution of sodium chloride, and the mixture is allowed to stand until it separates into an aqueous layer and an organic solvent layer. The aqueous layer is separated, and the remaining organic solvent layer is

rewashed with 1 liter of a saturated aqueous sodium chloride solution, and the mixture is again separated into two phases as above.

The layer of organic solvent thus separated is distilled under vacuum to recover the toluene. Thus, a concentrate of raw L-menthyl 3-hydroxybutyrate (495 g) is obtained. The concentrate is distilled by a Widmer coil (30 cm) to collect the fractions having boiling points ranging from 100 to 105°C/53 Pa (0.4 mm Hg). 465 g (1.92 mole) of L-menthyl 3-hydroxybutyrate is obtained, having the properties listed below. The yield is 96.1%.

d_{20}^{20}: 0.9793, n_D^{20}: 1.4603, $[\alpha]_D^{23}$: -64.9

UV: λ_{max} 218 nm

IR: (liquid film NaCl, cm^{-1}) 3440 (ν O–H), 1700 (ν C=O) (as indicated in Figure 1)

MS: (m/e): 243 (M + 1), 227, 155, 138, 123, 105, 95 (p), 81, 71, 57, 43, 29 (as indicated in Figure 2)

NMR ($CDCl_3$, ppm):

0.72-1.02 (11H; menthane 7-CH_3, 9-CH_3, 10-CH_3 and 5-H (ax), 6-H (ax))

1.22 (3H; d –CHOH–CH_3

1.02-2.28 (7H; menthane 2-H_2, 1-H, 4-H, 8-H, 5-H (aq), 6-H (aq))

2.21 (2H; d –OCO–CH_2–CHOH–)

3.05 (1H; t, t menthane 3-H)

4.74 (1H; t, 1 $-CH_2-CHOH-CH_3$) (as indicated in Figure 3).

Example 2

Preparation of L-Menthyl 3-Hydroxybutyrate by Catalytic Hydrogenation

505 g (2 moles) of the raw L-menthyl acetoacetate, with 95% purity, obtained in the reference example above, is introduced with 4.8 g of Raney nickel W-7 (a product of Kawaken Fine Chemical Co., Ltd.) into a 1 liter autoclave. Hydrogenation is performed under a hydrogen pressure of 6860 kPa (70 kg/cm^2) at a temperature ranging from 95 to 100°C, so that the L-menthyl acetoacetate absorbs the theoretical quantity of hydrogen. The reaction mixture is filtered through a glass filter to separate the catalyst used, and the filtrate is distilled by a Widmer coil to collect the fractions having a boiling point of 100-105°C/53 Pa (0.4 mm Hg). Thus 436 g (1.80 mole) of L-menthyl 3-hydroxybutyrate is obtained. The yield is 90.1%.

Example 3

Chewing Gum

	Parts by weight
Gum base	230
Powdered sugar	480
Glucose	160
Starch syrup	117
Plasticizer	1
Cola flavoring (produced by Takasago Perfumery Co., Ltd.)	10
L-menthyl 3-hydroxybutyrate	2
(Total)	1000

The above-listed ingredients are mixed in a dough mixer to prepare a chewing gum. This chewing gum is compared with a chewing gum prepared in the same way but without addition of the compound of the invention, L-menthyl 3-hydroxybutyrate. The result indicates that the addition of the compound of the invention reduces the power of the cola flavor, yielding a mellow sensation, and when the product is consumed, a cooling effect persists in the mouth for a long time.

Example 4

Hard Candy

	Parts by weight
Crystallized sugar	600
Starch syrup (water content 20%)	500
Water	250
(Total)	1350

The above-listed ingredients are mixed and heated at 150°C under atmospheric pressure in a conventional way to prepare a paste. Before the paste is solidified by cooling, 0.1% of a cider flavor (produced by Takasago Perfumery Co., Ltd.) and 0.5% of a 1% L-menthyl 3-hydroxybutyrate solution in ethyl alcohol are added to it, and the mixture is carefully mixed in a dough mixer to prepare a hard candy. The hard candy thus prepared is compared with a hard candy prepared in the same manner but without the addition of the compound of the invention, and the addition of the compound is found to reduce the harshness of the cider flavor, providing a sweet, pleasant flavor. Furthermore, a cooling effect is observed, which is generally absent when

sparking beverages such as cider are consumed (cooling effect associated with a sparkling sensation).

Example 5

Sherbet 5 [sic]

	Parts by weight
Grade A sugar	200
Powdered sugar syrup	40
Stabilizer	3
Caramel	appropriate amount
Cola flavor (produced by Takasago Perfumery Co., Ltd.)	1
L-menthyl 3-hydroxybutyrate (in 1% solution in ethanol)	5
Water to make	1000

The above-listed ingredients are mixed, and the mixture is placed in a freezer to prepare a sherbet. This sherbet is compared with a sherbet prepared in the same way but without the addition of the compound of the invention, ie, L-menthyl 3-hydroxybutyrate. The flavor in the sherbet containing the compound of the invention is observed to produce a sweet, pleasant sensation not produced by the sherbet prepared without the compound of the invention; and for a short period of time following consumption, a cooling effect is observed, which persists remarkably in the mouth.

Example 6

Soft Drink (Soda)

	Weight (g)
Crystallized sugar	700
Citric acid	4
Cider flavor (produced by Takasago Perfumery Co., Ltd.)	5
L-menthyl 3-hydroxybutyrate (in 1% solution in ethanol)	10
Water to make	1000 mL

The ingredients listed above are mixed to prepare a syrup. 35 mL of the syrup thus prepared and 165 mL of carbonated water (soda) are poured into a bottle and sterilized by heating at 70°C for 10 minutes to obtain a soft drink. Consumption of this soda beverage containing the compound, cooled to 5°C, produces a sweeter, cooler sensation than that of the beverage not containing the compound of the invention. That is, the carbonated beverage containing the compound of the invention is found to produce a sweet, pleasant sensation with a greater cooling effect than that of the carbonated beverage prepared without the compound of the invention.

Example 7

Skin Cream

	Parts by weight
Stearic acid monoglyceride	35
Stearic acid	47
Cetyl alcohol	17

Light mineral oil		140
Isopropyl myristate		30
Glycerin		80
Stearyl alcohol		32
Butylparaben		0.5
Methylparaben		0.5
Triethanolamine		1
Fragrance		3
Water		604
L-menthyl 3-hydroxybutyrate		10
	(Total)	1000

The above-listed ingredients are mixed thoroughly, with exception of the glycerin, the water and the fragrance, stirring and heating at about 70°C. The glycerin and water are added to the mixture at the same temperature, and stirring is continued. The resulting mixture is cooled with mild stirring. When the temperature of the mixture drops to about 50°C, the fragrance is added, and the mixture is cooled to ambient temperature with stirring. The result is a skin cream in accordance with the invention.

This cream, applied to the skin, does not produce any irritating odor, and even 30 minutes after application on the skin, the cooling effect is still present. This proves that the skin cream thus prepared has an excellent cooling effect.

Example 8

Skin Lotion

	Parts by weight
Ethanol	200
Propylene glycol	50
Glycerin	42
Methylparaben	1
Fragrance	2
Water	700
L-menthyl 3-hydroxybutyrate	5
(Total)	1000

The ingredients listed above are mixed in a conventional manner to prepare a skin lotion. This lotion, when applied to the skin, causes no irritating action. The cooling effect is distinctly present on the skin and persists there even after the cooling effect due to evaporation of the alcohol disappears.

Example 9

Antiperspirant Powder

	Parts by weight
Dimethylpolysiloxane	105
Squalane	155
Talc	325
Sericite	65
Aluminum hydroxychloride	270

Benzalkonium chloride	10
Lemon aroma (produced by Takasago Perfumery Co., Ltd.)	10
L-menthyl 3-hydroxybutyrate	60
(Total)	1000

The above-listed ingredients are mixed and carefully stirred at ambient temperature to form a homogeneous dispersion. This dispersion is poured into a pressurized tank in such a way that this pressurized tank is filled to one tenth its capacity with this dispersion, and freon gas is injected as a propellant. The result is an antiperspirant agent in the form of an antiperspirant spray powder. This powder has a pleasant odor and produces a potent cooling effect immediately after application due to evaporation of the sprayed antiperspirant agent. The cooling effect persists for a long period of time after evaporation of the sprayed antiperspirant agent from the skin.

Example 10

Hair Tonic

	Parts by weight
Ethanol	520
"Ho Leaf" oil	4
Polyoxyethylene sorbitan laurate	12
Propylene glycol	12
Triclosan	1
Fragrance	1
Water	445

L-menthyl 3-hydroxybutyrate		5
	(Total)	1000

The ingredients listed above are mixed to homogenization to obtain a hair tonic. When applied to the scalp, this hair tonic produces a cooling effect. This cooling effect persists for some time after the ethanol is completely evaporated.

Example 11

Shampoo

		Parts by weight
Sodium lauryl sulfate		100
Water		850
L-menthyl 3-hydroxybutyrate		50
	(Total)	1000

The above-listed ingredients are mixed and dispersed homogeneously to form a shampoo. When the hair is washed with this shampoo, a pleasant refreshing sensation is perceived, which persists for a long time.

Example 12

Lipstick

	Parts by weight
Castor oil	450
Hexadecyl alcohol	250
Lanolin	40

Beeswax		50
Lignite wax		40
Candelilla wax		70
Carnauba wax		20
Titanium oxide		20
Red No. 202		5
Red No. 204		25
Red No. 227 Al in lac form		15
L-menthyl 3-hydroxybutyrate		15
	(Total)	1000

The above-listed ingredients are mixed while heating and poured into a tank, and the mixture is cooled. The result is a lipstick. When applied to the lips, this cosmetic produces a pleasant cooling effect.

Example 13

Toothpaste

	Parts by weight
Dicalcium orthophosphate	500
Carboxymethyl cellulose	10
Sodium lauryl sulfate	20
Glycerin	250
Saccharin	2
Toothpaste flavor (produced by Takasago Perfumery Co., Ltd.)	8

L-menthyl 3-hydroxybutyrate		2
	(Total)	1000

The above-listed ingredients are mixed in a mixer to form a toothpaste. This paste, when applied to the teeth, provides a cooling effect without a bitter taste; the effect persists for a long time in the mouth.

Example 14

Anti-Itching Ointment

	Parts by weight
dL-Camphor	80
Methyl salicylate	20
Yellow vaseline	850
L-menthyl 3-hydroxybutyrate	50
(Total)	1000

The above-listed ingredients are carefully mixed to prepare an anti-itching ointment. When applied to the skin, this ointment produces a pleasant cooling effect which persists for a long time.

Example 15

Medicine for Internal Use for Digestion

	Parts by weight
Enzyme mixture for digestion	25
Cinnamon powder	7
Clove powder	2

Gentian powder	1
Sodium bicarbonate	655
Magnesium carbonate	100
Synthetic aluminum silicate	200
L-menthyl 3-hydroxybutyrate	10
Aqueous 1% ethanol to make	1000

The above-listed ingredients are carefully mixed to prepare an internal medicine for digestion. When administered, this medicine produces an agreeable taste and scent, with a cooling effect that extends from the mouth to the throat.

Example 16

Cigarette

	Parts by weight
Tobacco	980
L-menthyl 3-hydroxybutyrate	20
Aqueous 1% ethanol to make	1000

Tobacco from commercial cigarettes (Cherry brand) is used, and a solution of 1% L-menthyl 3-hydroxybutyrate in ethanol is sprayed onto the tobacco, then dried in air to eliminate the ethanol. Tobacco thus treated is again rolled into cigarettes. The tobacco, when smoked, produces a pleasant fresh sensation in the mouth which persists for a long period of time.

Example 17

Cigarette Filter

A filter is separated from the tobacco of commercial cigarettes (Cherry brand). The filter is dipped in a 1% solution of L-menthyl 3-hydroxybutyrate in ethanol to obtain a 0.05% L-menthyl 3-hydroxybutyrate concentration in the material of the filter. The filter is dried with a dryer (hot air) to eliminate the ethanol, and the filter is attached to the tobacco portion from which it had been detached. The cigarette thus prepared, when smoked, produces a sweet taste and a fresh sensation throughout the mouth.

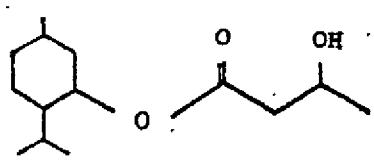
As described in detail above, in accordance with the invention, a new compound, ie, L-menthyl 3-hydroxybutyrate, is provided, which can be synthesized from cheaper raw materials, L-menthol and diketene, in only two synthesis stages, without any operational problem and with a high yield. Consequently, the preparation process of the compound is very useful from an industrial standpoint.

The cooling agent containing L-menthyl 3-hydroxybutyrate as the active ingredient, in accordance with the invention, produces an excellent cooling effect that can persist for a long time.

Furthermore, L-menthyl 3-hydroxybutyrate is a colorless, odorless compound which has no undesirable taste. This compound also possesses excellent stability, safety and solubility and can be used in different practical areas.

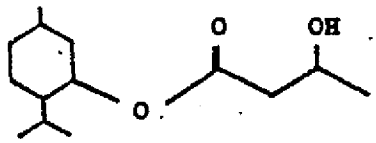
Claims

1. L-Menthyl 3-hydroxybutyrate of the formula



(I)

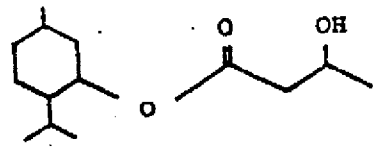
2. Process for preparing L-menthyl 3-hydroxybutyrate of the formula (I):



(I)

characterized by the fact that L-menthol is reacted with diketene in the presence of an alkaline catalyst to form L-menthyl acetoacetate, and this L-menthyl acetoacetate is reduced to obtain the L-menthyl 3-hydroxybutyrate.

3. Cooling agent containing, as an active ingredient, the L-menthyl 3-hydroxybutyrate of formula (I):



(I)

FIG. 1

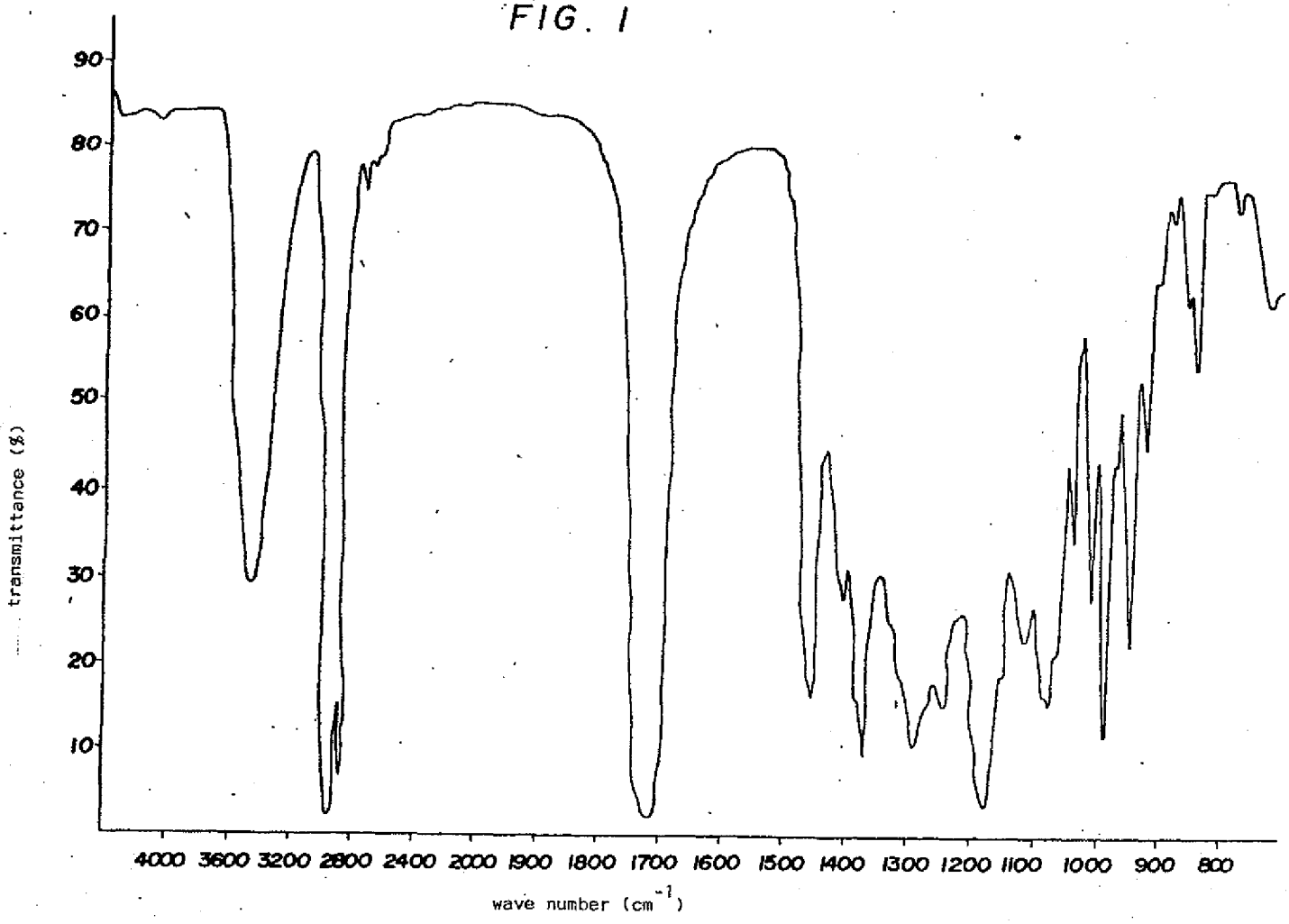

90
80
70
60
50
40
30
20
10
transmittance (%)
4000 3600 3200 2800 2400 2000 1900 1800 1700 1600 1500 1400 1300 1200 1100 1000 900 800
wave number (cm⁻¹)

FIG. 2

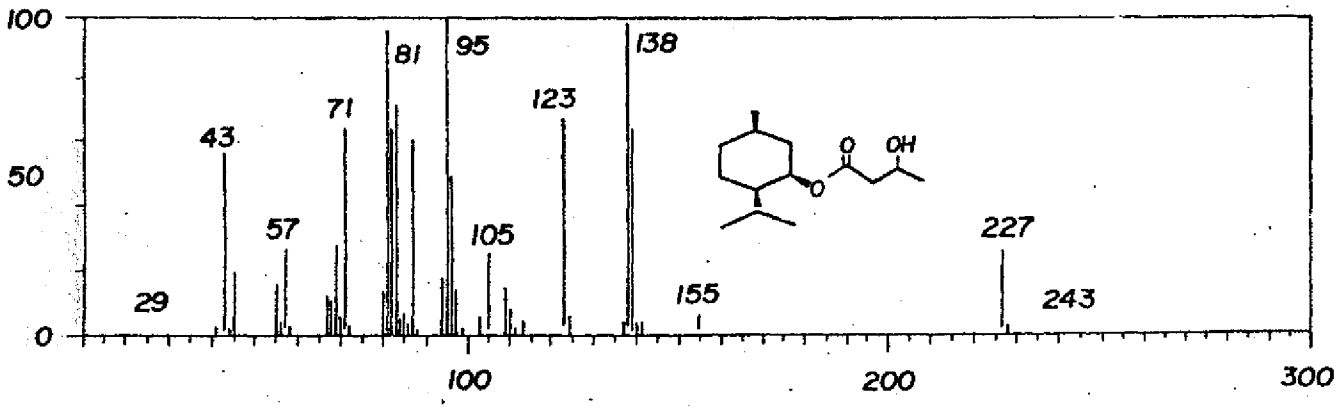


FIG. 3